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Towards Closing STEAM Diversity Gaps: A Grey Review of Existing Initiatives

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Abstract: Although STEAM (science, technology, engineering, art, and math) and student-centered instruction are growing rapidly in popularity, their reach is not adequately distributed across diversity groups (including individuals of different genders, economic backgrounds, immigrant backgrounds, abilities, and races, among other characteristics). The CreaSTEAM project intends to address diversity gaps by developing STEAM-Labs, student-centered spaces that combine components of fab labs, media labs, and user labs to specifically target diversity gaps. This paper carried out an informal PRISMA systematic review of a collection of 124 worldwide STEAM diversity initiatives to gather data on existing best practices that will be used in the STEAM-Labs. The review studied the geographic distributions, organizational structures, founding years, and activity offerings of the initiatives, along with the dataset's overall STEAM content area prevalence and diversity target area prevalence. STEM was the most common approach, and gender was the most common diversity target area. Since 2010 initiative creation has increased, with most growth in gender-focused initiatives.

Keywords: STEAM education; diversity; systematic reviews

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1. Introduction

STEAM (science, technology, engineering, art, and mathematics) education and student-centered instruction have seen significant growth in recent years, as shown by any number of studies, including project-based learning applied to robotics [1], project-based learning in STEAM art education [2], active learning studies in robotics [3], project-based learning in integrated science education [4], education 4.0 curriculum [5], active learning methodologies [6], maker spaces and fab labs [7,8] and the list can go on.

However, as much as these traditional pedagogies benefit their students and increase interest in STEAM fields, more work needs to be done to extend their benefits to diverse student groups (thinking broadly, "diversity" can include students of different cultures, abilities, ethnicities, genders, and sexual orientations) [9,10]. Certainly, recent decreases in the number of European women in STEM higher education indicate that we need to do more to attract and keep underrepresented groups in STEAM from primary school through college and into the workforce [9]. Recently, there has been significant interest from academia in addressing these diversity gaps. Studies have considered, for example, the lower rates of STEM degrees granted at US community colleges (which have higher rates of diversity than universities) and proposed equity-based strategies [11], the engineering gender gap in the UK and how it can be reduced with massive open online courses [12], the rates of women in PhD programs and the structural inequities and bias that participants face even as more women enroll [13], and STEM plus medicine racial diversity gaps in the US and proposals for strategic alliance partnerships and more equitable educational opportunities as initial solutions [14].

While these and numerous similarly oriented works are very important, they do not explicitly account for non-academic initiatives that work with students and others to address STEAM diversity gaps directly. This paper aims to find and analyze those non-academic sources, casting light on the full spectrum of available STEAM diversity approaches. We do this through the lens of CreaSTEAM, an EU-funded project whose goal is to improve diversity gaps through the creation of curriculum and lab spaces specifically targeted at students with gender, economic, different ability, and immigration diversity. CreaSTEAM attempts to do this by considering both existing STEAM pedagogies and less formal STEAM initiatives [9,10].

In terms of existing, established pedagogy, the project works to integrate fab labs, media labs, and user labs into a single, student-centered "STEAM-Lab" [9,10]. Fab, media, and user labs are maker spaces, where students learn by doing, creating their own academic projects and learning from their mistakes. Fab labs ("fab" is short for fabrication) are spaces with ample modeling and construction machines, such as 3D printers, laser cutters, and typical shop-class tools [8]. Media labs, which are less strictly defined, might provide students with media equipment: cameras, microphones, and editing software. The media lab at La Salle includes a motion capture laboratory with high-resolution cameras and a TV studio with cameras, video and audio mixers, lighting, and control racks [15]. User labs allow students to test their designs and may include testing and control rooms to observe how a creation is used. The former user lab at La Salle, for example, included a test room to watch users interact with a device, a domestic room to simulate at-home testing conditions, a focus group room, observation rooms for experts to monitor the tests, a mobile laboratory for taking tests into the field, and a control center for quantitative observation such as eye tracking [16]. Although fab, media, and user labs have different focuses, they provide students with the same experience: the labs' fundamental purpose is for students to learn actively by experimenting with and using real-life tools. The STEAM-Lab ideal promotes this purpose while encouraging students from diverse backgrounds to pursue STEAM.

In terms of potentially newer STEAM diversity pedagogy, this paper details the search and review of practical, on-the-ground initiatives that were carried out. We identify the trends in the initiatives developed regarding diversity target groups and STEAM content areas. We answer the following questions to obtain an overview of the results:

- MQ1: How are the selected initiatives distributed geographically?
- MQ2: What types of organizational structures do the selected initiatives have?
- MQ3: How are initiative founding years distributed?
- MQ4: How frequently are different activities offered by the selected initiatives?
- MQ5: How prevalent are the different STEAM content areas across the selected initiatives?
- MQ6: How prevalent are the different diversity target areas across the selected initiatives?

The paper is organized into five sections. The methodology behind the grey web search and subsequent review is described in Section 2. Section 3 provides curated data to respond to the investigation's mapping and research questions. Section 4 provides a review of the data presented, comparing the results with those from academic publications. Finally, the last section summarizes the conclusions.

2. Materials and Methods

To understand the methodology of this work, it is useful to look first at the context given by the CreaSTEAM project; starting from this point, the process can then be split into the development of a corpus of STEAM diversity initiatives and its review.

To deploy STEAM-Labs to improve diversity gaps, the CreaSTEAM project focuses on two concrete objectives: mapping STEAM diversity initiatives (IO1) and developing frameworks for implementing STEAM-Labs (IO2). These will be accomplished through the following phases:

- Phase 1, initiative mapping: Catalog existing diversity-focused groups, companies, and organizations to look for and analyze best practices to design the STEAM-Lab curriculum. Phase 1 is this paper's focus.
- Phase 2, STEAM-Lab design: Find key educational components that should be present in the labs, provide training for teachers who will be in the labs, and formalize the STEAM-Lab definition.
- Phase 3, pilot: Roll out the program in participating schools (which include partner educational associations, public schools, and additional associated schools in Germany, Italy, Spain, and Turkey).
- Phase 4, evaluation: Simultaneously with Phase 3, record data about the roll-out, including individual student profile evaluations.
- Phase 5, integration: Analyze the data from Phase 4 and finalize a STEAM-Lab methodology.

To develop the corpus of initiatives, we followed PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), a widely accepted process for objectively screening sources that will be used in systematic reviews [17,18]. We applied the following inclusion criteria:

- IC1: Initiative is focused on STEAM or diversity AND
- IC2: Initiative webpage has enough information in English or Spanish to gather data AND
- IC3: Initiative webpage is functional and securely accessible and pertains to the initiative AND
- IC4: Initiative is not better classified as another institution (such as a school or museum)

On the other hand, we formulated the following exclusion criteria:

- EC1: Initiative is not focused on STEAM or diversity OR
- EC2: Initiative webpage does not have enough information in English or Spanish to gather data OR
- EC3: Initiative webpage does not work, is not securely accessible, or does not pertain to the initiative OR
- EC4: Initiative is better classified as another institution

Additionally, because grey literature does not have embedded quality controls, the inclusion conditions were also used as the quality criteria.

The search for initiatives was carried out in different phases, in an ad hoc manner by many different participating universities and schools located in Germany, Italy, Spain, and Turkey. The searches occurred from February 2021 to May 2022 and gathered data from the internet, using Google, Bing, and DuckDuckGo web browsers. Search strings were made by combining terms from the following groups:

- Group 1 (geographic region): "Germany", "Italy", "Spain", "Turkey", "Europe", United States"
- Group 2 (content area): "Science", "Technology", "Engineering", "Art", "Math", "STEAM", "STEM"
- Group 3 (diversity target area): "Diversity", "Gender", "Women", "Girls", "Economic", "Immigration", "Disability", "Different ability", "Race", "Under-represented"
- Group 4 (additional): "Initiative", "Education"

To rapidly eliminate obviously irrelevant results returned by the search engines, EC1 was applied during the search process, before the PRISMA screening. Likewise, duplicates were removed before the formal screening process began. To avoid inconsistent labeling of the initiatives, the lead author screened all initiatives according to ECs 2, 3, and 4, and confirmed or updated the previously recorded information on each initiative's country, organizational type, activities, status (active or not), founding year, STEAM content areas, and diversity target areas (gender, economic, different ability, and immigration status). Initial searches focused on European initiatives, while later searches included initiatives in the United States, and added race as a diversity option. No independent system analysis was carried out on the categories tagged for each initiative, as they were taken from standards used in the CreaSTEAM Project.

Finally, the review of the initiatives' data was completed by the authors and is elaborated in the next section.

3. Results

Using the results obtained from the browsers using the given search terms and filtering according to EC1, the PRISMA analysis started with 148 grey web initiatives and ended with 124 selected initiatives, as shown in Figure 1 ([19] Tabs 1 and 2).

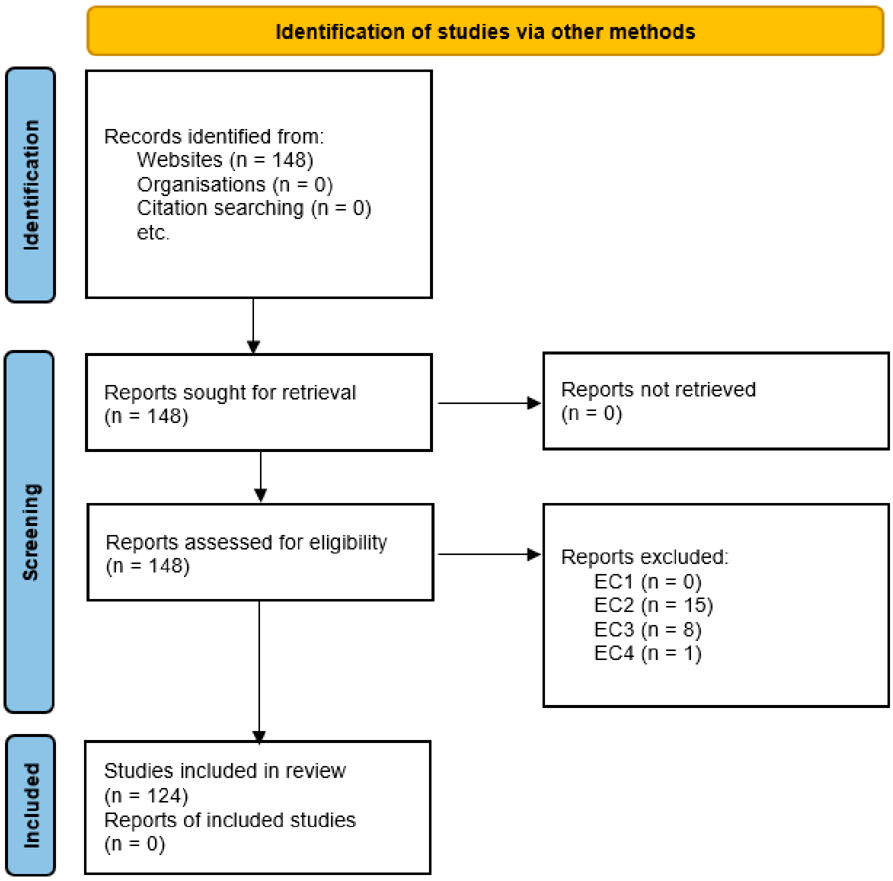

Figure 1. PRISMA flow diagram followed in the analysis. As no databases were consulted in the search, those flowchart boxes do not appear.

We now provide the results obtained by analyzing the selected initiatives, organized according to the MQs.

3.1. Initiative Metadata: Country, Organization Type, and Founding Year (MQs 1, 2, and 3)

The number of initiatives found per country or region is given in Table 1 ([19], Tab 3). Regions are listed when the initiative describes itself as working at that transnational level, "Worldwide," for example. Initiatives with a presence in multiple countries are tagged as operating in all of them.

Table 1. Number of initiatives per country. Regions ("Worldwide," "Europe," and "Latin America") correspond to initiatives that define themselves as working at the given level. Initiatives may be active (and thus, listed) in multiple countries.

Country	Initiatives	Country	Initiatives
Spain	56	Norway	3
Italy	29	Switzerland	3
Germany	19	The Czech Republic	3
Turkey	17	Bulgaria	2
UK	17	Europe	2
US	14	Lithuania	2
Belgium	12	Slovakia	2
The Netherlands	9	Bosnia and Herzegovina	1
Portugal	9	Chile	1
Worldwide	8	Columbia	1
Austria	7	Costa Rica	1
Finland	7	Croatia	1
Greece	7	Ecuador	1
Poland	7	Estonia	1
Sweden	6	Iceland	1
Romania	5	Latin America	1
Slovenia	5	Latvia	1
Denmark	4	Liechtenstein	1
France	4	Luxembourg	1
Hungary	4	Mexico	1
Ireland	4	Ukraine	1
Cyprus	3		

Organization type data are given in Figure 2 ([19], Tab 4). Projects are defined as short-term, time-constrained initiatives; organizations are groups that may run many projects, events, or other activities; networks are groups that connect interested people; associations are groups that offer membership and associated benefits; foundations are groups that provide funding or consulting, and that may be less directly connected with on-the-ground work; and laboratories are physical spaces that allow participants to do hands-on work. It should be noted that initiatives are tagged only as one organizational type, meaning that, for example, an initiative that runs several projects and operates a laboratory space would still likely be classified as an organization.

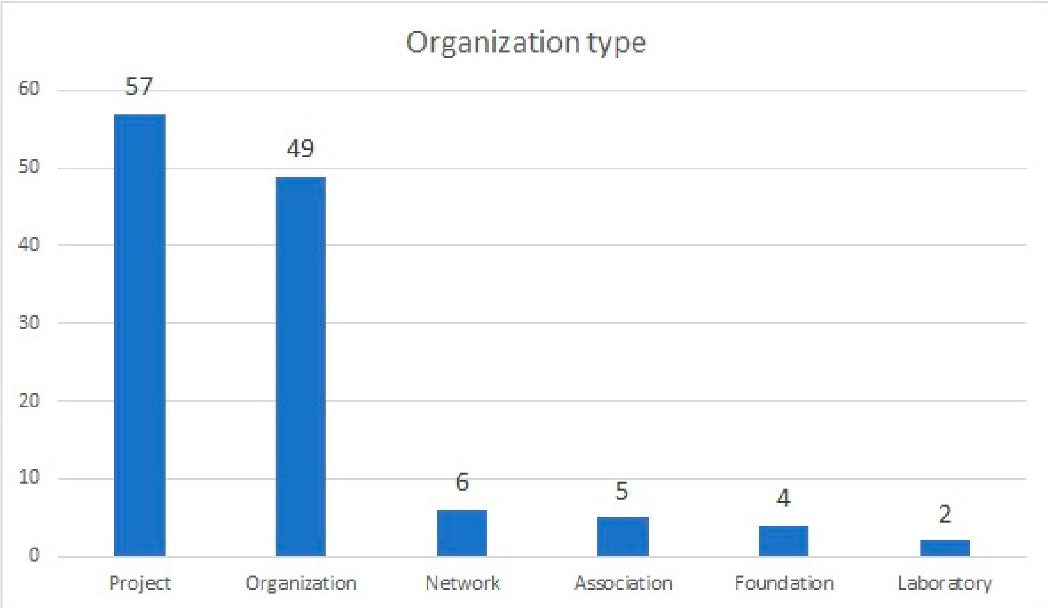

Figure 2. Initiative organization type.

Founding-year data since 1983 are given in Figure 3 ([19], Tab 7). To show the trend more clearly, one initiative founded in 1965 is omitted from the graph.

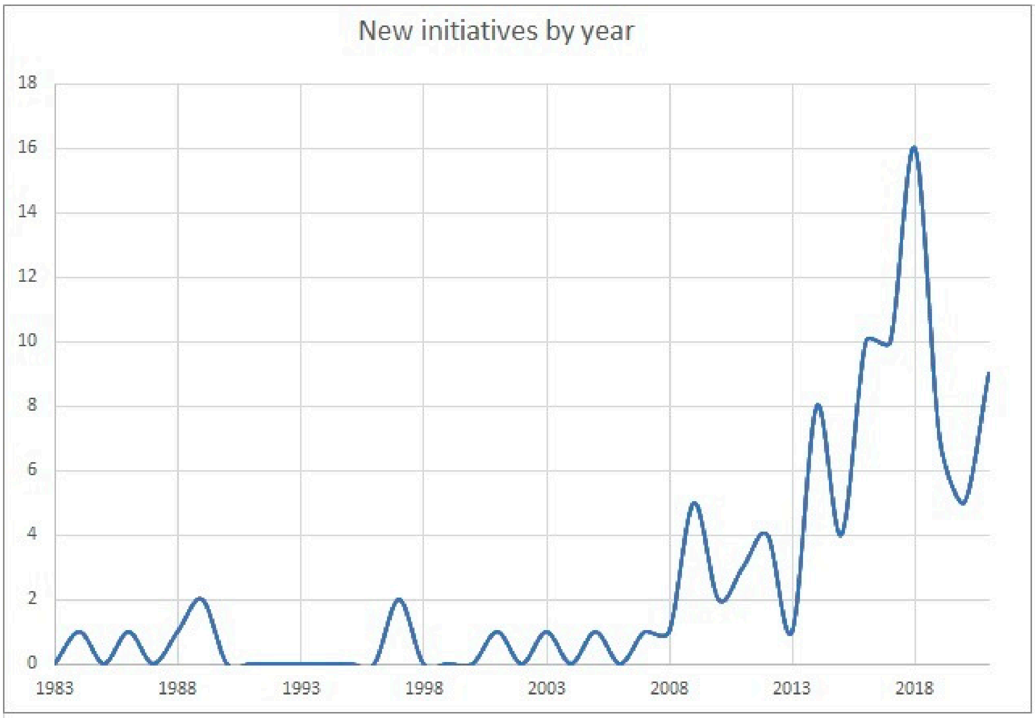

Figure 3. New initiatives by year, since 1983. The number of initiatives started during each year, excluding one initiative founded in 1965 to improve viewability.

3.2. Activity Data (MQ4)

Table 2 indicates the most popular activities for initiatives to offer, tagged by this paper's authors ([19], Tab 5). Some activities may appear to be redundant (e.g., "workshops" and "technical workshops"); the pairings represent what is believed to be the best possible description of each initiative's activities given the available tags.

Table 2. Activity offering data. The first column indicates the activity—tagged by researchers according to data on the initiatives' sites—and the second column indicates the number of initiatives offering that activity. Since many initiatives offer multiple activities, the total activities offered will exceed the number of initiatives.

Activity	Offerings	Activity	Offerings
Workshops	23	Events	10
Research	22	Youth camps	10
Educational content	21	Laboratory experiences	8
Educational courses	20	Online events	8
Technical workshops	19	STEAM awareness	8
Mentoring	16	Internships	6
Large-scale events	14	Networking	5
Problem-solving events	14	Scholarships/grants	5
Information exchange	12	Awards	3
Other activities	12	Teacher workshop	3
Seminars	12	Technical resources	2
Career workshops	10	Advocacy	2

3.3. STEAM Data (MQ5)

Table 3 gives the data on the prevalence of the five STEAM areas across the initiatives ([19], Tab 8). Technology is the most common content area, largely due to initiatives focusing purely on programming.

Table 3. STEAM content area prevalence. The number of initiatives focused on each content area. Since many initiatives are multidisciplinary, the total is greater than the number of initiatives.

Science	Technology	Engineering	Art	Math	None
81	109	80	29	70	10

Table 4 shows the number of initiatives offering different numbers of content areas as a measure of interdisciplinarity ([19], Tab 8). The initiatives with no STEAM content areas were still deemed to be closely related and met all inclusion conditions. One example is a network that supports women entrepreneurs who are not necessarily working in STEAM. A total of 24 (83%) of the initiatives with one content area were focused on technology; nearly all of them programming focused. Meanwhile, 45 (96%) of the initiatives with four content areas focused on STEM.

Table 4. Number of content areas prevalence. The number of initiatives with each number of content areas. For example, there are 29 initiatives with one content area.

Number of Content Areas	Number of Initiatives
0	10
1	29
2	10
3	4
4	47
5	24

3.4. Diversity Data (MQ6)

Table 5 contains data on the prevalence of each diversity area studied ([19], Tab 9). Since initiatives can have multiple focus areas, the total will exceed the number of initiatives. The initiatives with no diversity component were still determined to be closely related to the topic; one example is a research project investigating how to make STEAM education more accessible to students who are not necessarily from under-represented groups.

Table 5. Diversity target area prevalence. The number of initiatives found focused on each diversity area. Initiatives can have multiple diversity areas, so the total exceeds the number of initiatives.

Gender	Economic	Different Ability	Immigration	Race	None
102	27	1	26	10	7

As one view into specific diversity types, Figure 4 compares founding years since 1983 between gender-focused and non-gender-focused initiatives ([19], Tab 9). As in Figure 2, the initiative founded in 1965 is omitted; it is gender-focused.

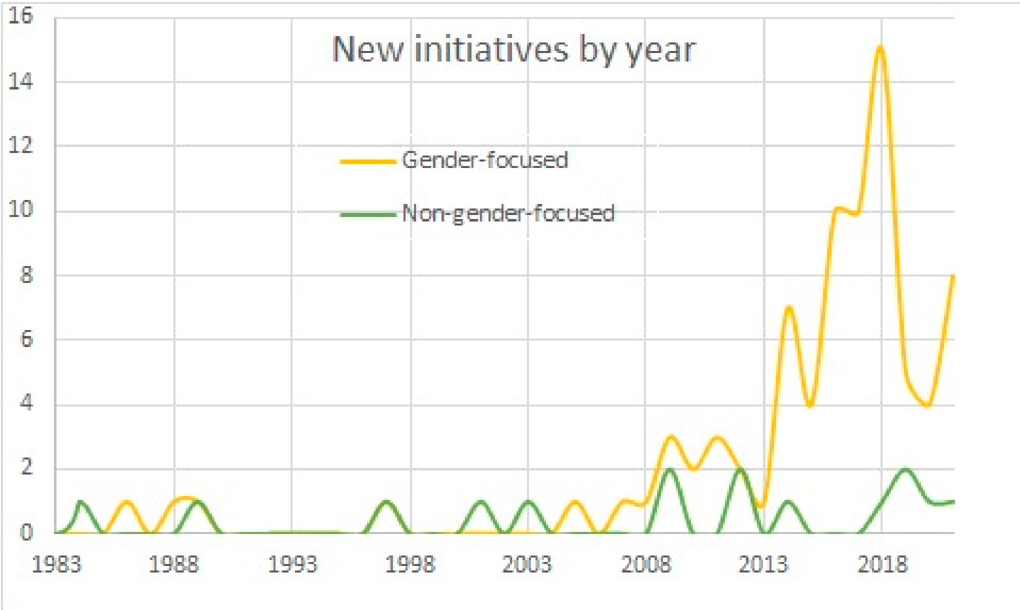

Figure 4. Gender-focused and non-gender-focused initiatives by founding year, since 1983. The graph excludes one gender-focused initiative founded in 1965 for viewability.

4. Discussion

One goal of this work is to begin to understand and bridge the gap between academically focused works and real-world efforts in STEAM diversity education. As such, in parallel with our review of the data from these on-the-ground initiatives, we compare results with those from an article that conducted a bibliometric analysis of the keywords of 1116 works focused on STEAM education found in the Web of Science database [20]. This work serves as a benchmark because it provides a broad, worldwide overview of the academic side of STEAM education from 2006 (when the term "STEAM" was coined) until 2020 [20]. Although the work does not focus explicitly on diversity, it makes many direct connections to it, and we find no other comparably large-scale study that explicitly deals with diversity.

In considering the results, we respond first to MQ1. As Table 1 shows, the countries of origin of the selected initiatives are heavily skewed towards the countries of origin of the participating research institutions—Germany Italy, Spain, and Turkey. Initially, this data can be seen not as an indicator of the countries with the most initiatives but rather as bias in the data gathering process. Certainly, we acknowledge that our search methodology limits our conclusions. However, the academic side sheds some additional light, indicating that after the powerhouse US (with 562 STEAM education publications), Spain comes in second with 71 (followed by Australia with 50 and England with 45) [20]. Adjusting for population, Spain (1.5 publications per one million people) and the US (1.7

publications per million people) have comparable publication outputs. Thus, we conclude that STEAM research and initiatives are indeed prevalent in Spain, not purely an artifact of the search process.

Turning next to MQ2, we examine Figure 2, which shows the distribution of the organizational structures of the selected initiatives, where the most common are clearly projects and organizations. The most prevalent could be due to different reasons. One possibility, of course, is that these types of structures are easier to create and maintain while reaching the greatest audience number possible. We should also remember, however, that these two structures are the broadest, and can act as umbrella terms for a variety of initiative types. For example, "projects" will apply to initiatives ranging from one-time student hackathons to funded research, while "laboratories" will be limited to initiatives that primarily offer a physical lab space for participants to use.

To answer MQ3, we consider Figure 3 and the rapid increase in STEAM diversity initiatives over time, beginning in the mid-2010s, that it shows. At a surface level, this is clear evidence that interest in STEAM and diversity is rising. However, by comparing these results with those presented in Figure 3 of our comparison article [20], we can extract deeper analyses due to a few key timepoints. Both datasets show steady but slow STEAM output from 2006 until 2010, called the "first stage of low production" [20], followed by rapid increases until 2018 for this paper and 2019 for its academic comparison [20]. The year 2020 was the first year of the Coronavirus pandemic outside of China, which explains why publications dropped the same year, and initiative creation appears to have dropped one year before; our search methodology did not return initiatives without a web presence, likely the case for initiatives founded just before the pandemic that did not survive. Given these trends, we conclude that STEAM diversity interest is increasing in the long term, and we forecast that as we move further away from pandemic conditions, STEAM diversity initiative creation will continue to grow.

Examining MQ4, Table 2 shows us the activity offering distribution, which is relatively linear, without big jumps in popularity between sequential activities. That "Workshops" is the most popular activity could be a sign of interest in hands-on, creative activities (versus "Seminars", for example), which bodes well for the CreaSTEAM project and its interest in creating makerspaces to deliver STEAM curriculums. Comparing this to the academic side, a preponderance of the studied works focused on developing creativity, and the authors encourage future studies to do the same [20].

In responding to MQ5, Tables 3 and 4, respectively, show the prevalence of the five STEAM content areas and the number of content areas offered. By far the most common content area combination is STEM, and we see from the relative under-representation of STEAM (and from the overall lack of art offerings) that the adoption of art as a component in technical curricula is still new. The popularity of technology is clear: it is the most common of the five contents areas and represents 24 (83%) of the one-area initiatives (almost all of which focus on programming). Comparing again to the academic side, we see mostly similarities. Tab 10 in the comparison article presents the principal research themes in the dataset, classified by the time in which each is prevalent (2006–2015, 2016–2018, 2019–2020) [20]. In agreement with this work's data, "STEM", "STEM education", and "STEM teachers training" appear, respectively, in the three time ranges, "Arts" appears only in 2019–2020, and "Technology" appears from 2006–2015. Technology is the most easily implemented STEAM area via programming, but given the evolution seen, we forecast that art and initiatives that include art will become more popular over time.

Finally, we consider MQ6. Table 5 gives the prevalence of each diversity target area. The data presented there raises interesting discussions on two different tracks: gender and race.

Gender-focused initiatives are by far the most dominant, with 102 (82%) having "gender" as a focus area (although, it should be noted that initiatives can work in multiple diversity target areas, so not all those 102 initiatives solely target gender). Figure 4 sheds more light on the source of these initiatives—the explosion in new initiatives since approximately 2010 is due almost entirely to gender-focused programs. It appears that the academic side echoes this emphasis, and Tab 10 [20] displays this evolution, with “Women” a principal research theme in 2006–2015, the more inclusive “Gender” and “Gender differences” principal themes in 2016–2018, and the most general of all, “Broadening participation”, in 2019–2020. Given these trends, we conclude that a gender focus in STEAM education is both necessary and fruitful, and we forecast that future initiatives will continue to have gender components that are more and more open to widely defined gender groups.

At the same time, the race-focused initiatives deserve special explanation: since the initiative search began in Europe, there was little need to tag race-focused initiatives because initiatives that catered to racial diversity could also be correctly defined as catering to immigration diversity. “Race” was added to describe initiatives in the United States, where race is a major and unique diversity indicator; the tag has only been applied to initiatives based in the US. Additionally, of the 14 US initiatives, 10 (71%) focus on race. The academic side shows an increasing interest in race-based initiatives, reporting “Race” as a top theme in 2016–2018 and “Segregation” in 2019–2020 [20].

Finally, we turn to RQ1. The most notable trend in the selected initiatives is visible in Figure 3, which shows the rapid increase in initiative creation beginning in the last 10 years. The first assertion we can make is that there is significant and growing demand for STEAM diversity initiatives. Breaking this data down further, we can turn to Figure 4 to see the cause of this growth and assert that virtually all that demand comes from initiatives that target gender.

Considering the diversity side, Table 5 indicates the popularity of the other diversity target areas, with economic and immigration diversities approximately equally common, followed by racial diversity, no specific diversity, and different abilities. Considering the STEAM side, Tables 3 and 4 indicate that STEM is the most common content area combination, followed by equally popular STEAM and Technology. To the extent allowed by our search methodology limitations, these trends indicate the current state of STEAM diversity initiatives.

To show more concretely the significance of this study’s work, we consider the example of Germany, where STEAM education is only recently entering national curriculum [21]. Despite little national STEAM curriculum and virtually no interdisciplinary work, STEAM education is seen as an important societal and political issue [21]. The gap between the formal education system and the public view on STEAM is bridged by informal initiatives, many of which appear in this dataset. Thus, identifying country-specific STEAM diversity data, projects, and best practices is important so that we can define potentially successful research projects and initiatives that can continue to bridge country gaps between the demand for STEAM and standard educational offerings of STEAM.

We close the Discussion section by elaborating and responding to the study’s methodology limitations:

(1) The study relies on a grey web search: its findings are not repeatable and rely on unverified information from the internet.

This is true but also unavoidable. This study aims to find initiatives that are not necessarily available through academic sources but still offer best practices and data points. There is no other way to find this type of initiative. Additionally, from another perspective the dataset is indicative of what an interested parent or student (of any age) would be likely to find if they searched for an initiative to match their interests and is, thus, a good indicator of the state of STEAM diversity initiatives.

(2) The study’s dataset presents a country bias towards the research institution origin countries.

This is also true, and we acknowledge that the scope of our conclusions is limited by this fact.

(3) The study's dataset was created and tagged by many researchers: data and interpretations are inconsistent.

At the final stage of data processing, all initiative entries were checked by this paper's lead author. While inconsistencies may exist, they have been minimized as much as possible.

5. Conclusions

This paper documents the first objective of the CreaSTEAM project, which is to create a mapping of existing STEAM diversity initiatives. This data will be used to complete the project's overall goal of designing a curriculum for interactive STEAM-Labs that will focus on improving diversity gaps. To accomplish this objective, we completed a pseudo-PRISMA systematic review, searching for STEAM diversity initiatives on the grey web that we filtered with inclusion and exclusion conditions. We then guided our data review through mapping questions that gave data on initiative countries, organizational structures, founding years, activity offerings, STEAM content area prevalence, and diversity target area prevalence, with the end goal of answering our research question of what diversity and STEAM trends could be observed in the selected initiatives.

Our dataset included 124 worldwide initiatives focused on STEAM or diversity, the data for which are available online [19]. Most of these initiatives were founded relatively recently, with a jump beginning in the early 2010s that shows increasing interest in STEAM and diversity. STEM is the most common content area configuration, and Technology is the most common content area overall. Considering diversity target areas, gender is by far the most common, and its popularity has especially grown recently. Race is a major diversity area in the United States but is much less prominent in Europe. Throughout our discussion, we have compared the on-the-ground initiative results with academic publications collected in [20]. We have drawn the following conclusions:

- Despite the bias in our search process, Spain is indeed a leader in STEAM education, as is the US.
- We see a clearly increasing interest in STEAM education to diverse groups. There have been major setbacks due to the Coronavirus pandemic, but we expect that as we continue to leave the crisis, initiative creation and interest will return.
- We see a lower interest in the art side of STEAM, but we expect its recent growth, from its addition to STEM in 2006 to its entry as a principal research theme in 2019, to continue. We see the addition of Art as a necessary component of developing creativity in diverse STEAM students.
- We note strong interest in gender-based initiatives, with an increasingly inclusive idea of what gender is. That the recent growth in initiative creation comes from targeting gender shows how important it is as a diversity area, and we predict that STEAM growth in this area will continue.
- STEAM diversity initiatives are an important way of bridging the gaps between offerings of standard educational curriculums and the demand from students and society.

We acknowledge that these conclusions come with caveats. As a grey web search, this study comes with inherent limitations that we have attempted to minimize as much as possible. We acknowledge that the findings are not repeatable or verifiable; we accept this as necessary to complete the desired review. There is a country bias towards Spain, Italy, Germany, and Turkey in the results; we acknowledge this when making conclusions. The dataset was not created by a single entity or with a consistent process; we again see this as necessary if we wish to gather enough grey web data, and we have mitigated the effects by subjecting the entries to a final, single-researcher review. Despite these drawbacks, this research presents an indication of the current state of STEAM diversity initiatives and offers directions for future work, which we propose below.

The most concrete next step will be linked to the CreaSTEAM project and the creation of its STEAM-Labs. As we explained in the introduction, the data from the initiatives analyzed in this paper will be used to find best practices and create a curriculum for the labs, which will then be tested. Beyond this, the next direction for future work is in maintaining and updating the dataset. Existing initiatives will continuously change and end, and new initiatives will be created, especially if the growth trend we currently see continues. Continuing to search for initiatives while tracking already recorded ones will make the dataset more robust and paint a more complete picture of the present state of STEAM diversity initiatives.

Future work could also consider more deeply the diversity target areas. For example, race is clearly an interesting factor given how geographically divided its impact is; differences in best practices between the US and Europe through the lens of race could be studied. Intersectionality (the combination of multiple diversity areas) could be investigated as well. If an individual belongs to multiple diversity groups, how can they best be served? What differences exist between single-diversity area and intersectional initiatives (respectively 67.7% and 32.3% of the dataset)? Continuing work on the CreaSTEAM project and on this research will shed more light on the diversity gaps in STEAM and provide more ways to overcome them.

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